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Research Article

Effects of the ACTIVE training program on teachers' development of key competency-based active learning and project-based learning

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Abstract

This study examined the effects of the ACTIVE Training Program on teachers' development of competency-based active learning and project-based learning (PBL). The ACTIVE Training Program—Activate-Connect-Transform-Integrate-Validate-Empower—was designed to address the gap between Thailand's educational policies and classroom implementation. Using a mixed-methods pre-experimental design, the study involved 50 basic education teachers from a private elementary school in Satun province, Thailand. Results demonstrated significant improvement in teachers' knowledge, with a normalized gain index of 0.77 (high level), and mean scores increasing from 9.68 to 17.58 points. Teachers showed high ability in designing learning activities integrating four active learning dimensions with five key competencies. Qualitative analysis revealed substantial changes in understanding of active learning concepts (62.00%), learning activity design skills (38.00%), and classroom application intentions (82.00%). Activities with greatest impact included the self-reflection letter writing and thinking/problem-solving tasks. Teachers reported highest satisfaction with the trainer and atmosphere, followed by the training process. The findings suggest that structured professional development incorporating emotional engagement, reflective practice, and collaborative design can transform teachers from content deliverers to learning architects capable of implementing competency-based education. The study contributes to understanding how teacher training can bridge policy-practice gaps in the Thai context, while offering a promising approach for teacher professional development aligned with 21st-century learning.

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Introduction

In the 21st century, the world is experiencing rapid and complex changes across technological, economic, social, and environmental dimensions. These transformations have necessitated urgent shifts in global education systems from content-based knowledge toward comprehensive competency development (World Economic Forum, 2023, p. 4; OECD, 2023, p. 3). Higher-order thinking abilities, creative problem-solving, communication, collaboration, and lifelong learning have become essential components of contemporary learning approaches.Thailand has established policies and educational development guidelines aligned with these global changes, such as the National Education Plan 2017-2036, which emphasizes learner competency development in line with the vision of "Thai people being high quality citizens of the country and the world" (Office of the Education Council, 2023, p. 6). However, policy reviews by OECD and UNESCO indicate that Thailand's education system still faces challenges in curriculum development, competency

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assessment, teacher preparation, and technology integration for learning (OECD/UNESCO, 2016, pp. 4-5). Research on Future Trends in Thai Education 2030 reveals that Thailand continues to emphasize fragmented learning approaches, lacking integration between knowledge, skills, and learner characteristics. Additionally, technology use remains limited in fostering participatory learning (Office of the Education Council, 2016, pp. 10–12). These challenges are evident at the school level. For instance, in the participating school—despite having a vision aligned with active learning and a commitment to moral, academic, and language development—teachers still encounter limitations in designing well-integrated activities that balance physical, mental, social, and intellectual dimensions while authentically connecting to core student competencies. To address these challenges through teacher professional development, the researcher has specifically designed the 'ACTIVE' Training Program as a teacher training methodology. This process—Activate-Connect-Transform-Integrate-Validate-Empower—aims to equip teachers with the knowledge and skills needed to implement competency-based active learning and Project-Based Learning (PBL) in their classrooms. Each component of the ACTIVE process serves a specific purpose in transforming teacher practice: 1) Activate stimulates teachers' awareness and enables context analysis; 2) Connect helps teachers link core concepts with student competencies; 3) Transform facilitates mindset shifts through student-centered approaches like PBL; 4) Integrate guides teachers in balancing physical-mental-social-intellectual dimensions in learning activities; 5) Validate creates opportunities for teachers to present their instructional designs and receive peer feedback; and 6) Empower strengthens teachers' professional capacity and supports implementation planning for their specific classroom contexts. This teacher training approach aligns with contemporary professional development trends that position teachers as learning designers and "change agents" rather than mere policy implementers (OECD, 2021, p. 3; WEF, 2024, p. 5). By focusing on teacher development through the ACTIVE process, this research aims to bridge the gap between educational policy and classroom practice, ultimately enhancing student learning experiences.

Therefore, this research examines the effects of the 'ACTIVE' Training Program on teacher development, specifically investigating how this structured training approach impacts teachers' knowledge, skills, and attitudes regarding competency-based active learning and PBL. The study seeks to determine whether teachers trained through this process can effectively design and implement learning activities that integrate student competencies with active learning approaches in ways that align with institutional, national, and global educational goals.

Objectives

This study examined the effects of the 'ACTIVE' Training Program on teachers' development of competency-based active learning and project-based learning. Specifically, this study aimed to:

- Determine the extent to which teachers' knowledge and understanding of competency-based active learning and project-based learning increased after participating in the ACTIVE training program;
- Assess the level of ability teachers demonstrated in designing learning activities using competency-based active learning and project-based learning concepts;
- Explore how teachers reflected on their professional learning experiences and pedagogical changes after the training program; and
- Evaluate teachers' satisfaction with the format, content, and process of the ACTIVE training program.

Research Problems

The main research problem focuses on investigating how the 'ACTIVE' Training Program affects teachers' knowledge, abilities, reflections, and satisfaction regarding competency-based active learning and project-based learning. Specific sub-problems include:

- To what extent does teachers' knowledge and understanding of competency-based active learning and project-based learning (PBL) increase after participating in the ACTIVE training program compared to before training?
- What level of ability do teachers demonstrate in designing learning activities using competency-based active learning and project-based learning concepts during the ACTIVE training process?
- How do teachers reflect on their professional learning experiences and pedagogical changes after participating in the ACTIVE training program?

- What is the level of teacher satisfaction with the format, content, and process of the ACTIVE learning training program?

Method

Research Design

This study employed a mixed-methods pre-experimental design (one-group pretest-posttest) to evaluate the effects of the 'ACTIVE' Training Program on teacher development. Quantitative methods assessed changes in teachers' knowledge and measured satisfaction levels using rating scales, while both quantitative and qualitative methods were employed to analyze teachers' reflections and satisfaction with the training. This methodological approach allowed for comprehensive evaluation of both objective learning outcomes and subjective participant experiences, aligning with contemporary program evaluation practices in educational research. The design was appropriate for this educational context despite lacking a control group, as it efficiently measured specific intervention effects within resource constraints.

Participants and Sampling

The study initially had 60 registered participants, including 5 male teachers (8.33%) and 55 female teachers (91.67%). However, the final sample consisted of 50 basic education teachers (45 females and 5 males) who completed both the pre-test and post-test and consented to have their data used in the research. Most participants (48%) were aged 35-44 years, followed by those aged 25-34 years (30%), and 45-54 years (14%). Participants represented various subject areas, with the largest group teaching at the early childhood level (32%), followed by foreign languages (20%), Thai language (14%), science and technology (12%), and mathematics (10%). Participants were recruited through purposive sampling from a private school in Satun province that promotes active learning policies and provides opportunities for continuous professional development for teachers.

Data Collection Tools

The research instruments included: Knowledge assessment test: A 20-point pre-test and post-test to measure teachers' knowledge and understanding of competency-based active learning and project-based learning before and after training. Learning activity design assessment forms: Rubric-based assessment tools using 5-3-1 scoring criteria to evaluate teachers' ability to design learning activities during the training. The assessment covered six dimensions: alignment with Active Learning 4 dimensions, integration of 5 key competencies, implementation of Project-Based Learning concepts, contextual relevance and feasibility, reflective practice, and creativity and application. Reflection forms: Open-ended questionnaires capturing teachers' reflections on their key learning points, impactful activities, changes in perspectives, and intentions to apply knowledge after participating in the training. Satisfaction questionnaire: A 5-point Likert scale survey (1.00-1.80 = lowest, 1.81-2.60 = low, 2.61-3.40 = moderate, 3.41-4.20 = high, 4.21-5.00 = highest) to assess teachers' satisfaction with the format, content, and process of the ACTIVE learning training across three main categories: content satisfaction, training process satisfaction, and trainer and atmosphere satisfaction.

Instrument Validation

All research instruments underwent a rigorous validation process to ensure their content validity before implementation. A panel of four experts with backgrounds in educational measurement and evaluation (1), curriculum and instruction (2), and Project-Based Learning and Training (1) reviewed the instruments. These experts assessed each item's relevance, clarity, and appropriateness using the Index of Item-Objective Congruence (IOC) method.

The expert validation yielded positive results across all instruments. The knowledge assessment test received an IOC score range of 0.67-1.00 with a mean IOC of 0.89, indicating strong content validity. The learning activity design assessment forms received an IOC range of 0.67-1.00 with a mean of 0.91. The reflection forms and satisfaction questionnaire received IOC scores of 0.78 and 0.86 respectively, both exceeding the 0.60 threshold for acceptable content validity.

Expert feedback included recommendations for minor revisions to improve clarity and precision. These included revising certain knowledge test items to eliminate ambiguity, refining the wording of some rubric descriptors in the

assessment forms, adding more specific prompts to the reflection forms, and adjusting the satisfaction questionnaire rating scale descriptors. All recommended modifications were implemented before finalizing the instruments for data collection, ensuring that they accurately measured the intended constructs and were appropriate for the target participants.

Data Analysis

The collected data were analyzed using the following methods:

Quantitative analysis

Descriptive statistics (frequency, percentage, mean, standard deviation) were used to analyze demographic data, knowledge test scores, and satisfaction levels.

The normalized gain index (g = [post-test score - pre-test score]/[maximum score - pre-test score]) was calculated to determine the level of improvement in teachers' knowledge, with interpretation criteria: <0.30 = low level, 0.30-0.70 = medium level, >0.70 = high level (Hake, 1998).

Score distribution analysis was conducted to examine the pattern of changes in teachers' knowledge levels before and after training.

Qualitative analysis

Content analysis was applied to examine teachers' reflection responses, categorizing the data into themes and calculating frequencies and percentages for each theme.

Four main areas of reflection were analyzed: key learning points from the training, activities that most impacted teachers' thoughts and feelings, changes in perspectives after training, and intentions to apply knowledge from the training.

Representative quotes from teachers were selected to provide deeper insights into their learning experiences and changes in perspectives.

Procedure

The training and data collection were conducted on May 14-15, 2025, at a private school in Satun province. The training followed the 'ACTIVE' Training Program developed by the researcher:

Activate: Stimulating awareness of the importance of change in teaching approaches through engaging activities such as brain gym exercises, thought-provoking games like the Hanoi Tower, and emotional video clips that connected with teachers' personal experiences and motivations.

Connect: Linking competency-based concepts with teachers' experiences, focusing on Active Learning 4 dimensions (physical, emotional, social, and intellectual) and the five key competencies (communication, thinking, problem-solving, life skills, and technology use).

Transform: Transforming thinking paradigms through new approaches such as PBL, challenging teachers to reconsider traditional teaching methods and adopt more student-centered approaches.

Integrate: Guiding teachers to design learning activities that integrate Active Learning 4 dimensions, competencies, and PBL principles, with opportunities for hands-on practice and collaborative work.

Validate: Creating space for teachers to present their learning designs and exchange constructive feedback with peers, fostering a professional learning community.

After the Validate phase, the post-test and reflection questionnaires were administered to collect data on knowledge gains and teachers' opinions about the training experience. This strategic timing ensured that all participants completed the assessments before proceeding to the final phase.

Empower: For the final phase, teachers created encouraging messages on post-it notes to share with the entire group. In a symbolic act of community and shared purpose, teachers collaboratively arranged these notes to form the abbreviation of their school name, surrounding it with marbles in a heart shape. This visual representation symbolized their collective commitment to the school's vision and to implementing the new teaching approaches. Selected representatives then delivered motivational speeches to their colleagues, reinforcing the community of practice and strengthening their dedication to transforming classroom practice.

This thoughtfully designed conclusion to the 'ACTIVE' Training Program not only collected comprehensive data but also created a meaningful, emotionally resonant experience that strengthened teachers' sense of community and purpose as they prepared to implement their new knowledge in their classrooms.

Results

To address the research problems investigating the effects of the 'ACTIVE' Training Program on teachers' development, the findings are presented in four sections corresponding to each research sub-problem. Prior to these results, demographic data of the participants are described to provide context for the study.

Teachers' Knowledge and Understanding Before and After Training

The first research problem examined the extent to which teachers' knowledge and understanding of key competency-based active learning and project-based learning increased after participating in the 'ACTIVE' Training Program compared to before training.

Table 1. Mean scores, standard deviation, gain scores, and normalized gain index of teachers' knowledge and understanding before and after training (n = 50)

Test	Maximum Score	Mean	SD	Gain Score	% Gain	Normalized Gain*	Interpretation
Pre-training	20	9.68	3.22	7.90	39.50	0.77	High level
Post-training	20	17.58	2.95				

Normalized Gain (g) = (Post-test score - Pre-test score)/(Maximum score - Pre-test score), with interpretation criteria: <0.30 = low level, 0.30-0.70 = medium level, >0.70 = high level (Hake, 1998)

The analysis revealed that before training, teachers had a mean score of 9.68 points (SD=3.22), which increased to 17.58 points (SD=2.95) after training. The average gain was 7.90 points, representing a 39.50% improvement. The normalized gain index of 0.77 indicates a high level of improvement according to Hake's (1998) criteria.

The score distribution analysis showed a clear shift in performance levels. Before training, most teachers (48.00%) scored in the 6-10 range, while after training, the majority (80.00%) scored in the high range (16-20 points), as shown in Table 2.

Table 2. Frequency distribution and percentage of teachers' knowledge and understanding scores before and after training

Score Range	Pre-training		Post-training	
	Frequency	Percentage	Frequency	Percentage
16-20	4	8.00	40	80.00
11-15	14	28.00	8	16.00
6-10	24	48.00	2	4.00
0-5	8	16.00	0	0.00
Total	50	100.00	50	100.00

The areas where teachers showed the most significant improvement were in understanding key competency-based learning design connected to real-life situations and backwards assessment, with correct responses increasing from 34.00% to 92.00% and from 36.00% to 90.00%, respectively.

These findings indicate that the 'ACTIVE' Training Program was highly effective in enhancing teachers' knowledge and understanding of key competency-based active learning and project-based learning, with improvement measured at a high level according to established educational research criteria.

Teachers' Ability to Design Learning Activities

The second research problem examined teachers' abilities to design learning activities using competency-based active learning and project-based learning concepts during the 'ACTIVE' Training Program.

Teachers were divided into 7 teams, and their learning activity designs were evaluated using a 5-3-1 scoring rubric (excellent-satisfactory-needs improvement) across six dimensions. Analysis of the designs revealed the following:

Table 3. Assessment scores of teachers' learning activity designs

Teacher Team	D1: Active Learning 4 Dimensions	D2: 5 Key Competencies	D3: PBL Implementation	D4: Contextual Relevance	D5: Reflective Practice	D6: Creativity	Total Score (out of 30)
1.1	5	5	5	5	4	5	29
1.2	5	5	5	5	4	5	29
2.1	5	5	5	5	4	5	29
2.2.1	3	3	3	5	3	3	20
2.2.2	5	5	5	5	3	3	26
3.1	3	3	3	3	3	3	18
3.2	4	4	4	4	3	4	23
Mean	4.29	4.29	4.29	4.57	3.43	4.00	24.86
SD	0.95	0.95	0.95	0.79	0.53	0.96	4.74

The overall mean score (24.86/30 or 82.87%) indicates a high level of ability in designing activities that incorporate competency-based active learning and project-based learning principles. "Contextual relevance and feasibility" received the highest average score (4.57/5), while "Reflective practice" scored lowest (3.43/5) with the smallest standard deviation (0.53), suggesting a consistent area for improvement across all teams.

High-scoring designs demonstrated: (1) explicit integration of all four active learning dimensions; (2) clear connections between activities and competencies; (3) well-structured PBL methodology; (4) strong real-world relevance; and (5) innovative applications in culturally appropriate contexts.

Common areas for improvement included: (1) enhancing reflection components; (2) strengthening competency-activity connections; (3) providing more detailed implementation guidance; (4) better balancing emotional and social dimensions; and (5) incorporating more diverse technological applications.

These findings indicate that the 'ACTIVE' Training Program effectively developed teachers' abilities to design competency-based active learning and project-based learning activities, while highlighting reflection as an area requiring continued professional development.

Teachers' Reflections on Learning Experiences and Changes

The third research problem examined teachers' reflections on their learning experiences and changes after participating in the 'ACTIVE' Training Program. Qualitative content analysis of open-ended responses from 50 participants revealed significant reflective patterns across key areas.

Key Learning Points from the Training Program

Content analysis of responses to the question "What was the most important thing you learned from this training program?" revealed several significant themes as presented in Table 4.

Table 4. Frequency and percentage of key learning points from the training program

Key Learning Points	Frequency	Percentage
1. Conceptual Knowledge and Principles	31	62.00
- Active Learning	10	20.00
- Key Competency-Based Learning	8	16.00
- Project-Based Learning (PBL)	4	8.00
- Four-Dimensional Active Learning (Physical-Emotional-Social-Intellectual)	9	18.00
2. Learning Activity Design and Implementation Skills	19	38.00
- Designing Diverse Activities	8	16.00
- Integrating Learning	5	10.00
- New Teaching Techniques and Processes	6	12.00
3. Classroom Application	8	16.00
- Applying Knowledge in Classrooms	7	14.00
- Application Across Subject Areas	1	2.00
4. Collaborative Skills	7	14.00
- Unity and Teamwork	5	10.00
- Exchange of Ideas	2	4.00
5. Training Experience	4	8.00
- Enjoyable Training Atmosphere	3	6.00
- Trainer Quality	1	2.00
6. Thinking Skills	7	14.00
- Analytical Thinking and Creativity	5	10.00
- Thought Stimulation	2	4.00
No Response	3	6.00

Note: Table shows frequency of learning points mentioned by teachers from a total of 50 respondents, calculated as percentage of all teachers mentioning each point. Some teachers mentioned multiple points.

The majority of participating teachers (62.00%) identified conceptual knowledge and principles as their most important learning, particularly "Active Learning" (20.00%) and "Four-Dimensional Active Learning" (18.00%), which directly aligned with the main objectives of the training program. Learning activity design and implementation skills ranked second (38.00%), with "Designing Diverse Activities" being the most frequently mentioned (16.00%).

Teachers also valued classroom application (16.00%), indicating that the training program motivated them to transfer their newly acquired knowledge to authentic teaching contexts. "Collaborative Skills" (14.00%) and "Thinking Skills" (14.00%) were equally emphasized, reflecting the 'ACTIVE' Training Program's comprehensive development of knowledge, practical skills, and collaborative attributes.

Representative quotes included:

Regarding conceptual knowledge: *"Active Learning requires placing students at the center of learning while teachers function as scenario designers to develop real-life competencies and project-based learning."*

> Regarding learning activity design: *"Diverse activities can be integrated across subject areas to help students gain knowledge, stimulate interest, and participate. For example, in Thai language learning, the magical box arrangement activity (using the same principle as Tower of Hanoi but with 5 different-sized plastic boxes) can be used for proverb learning."*
>
> Regarding classroom application: *"Learning four-dimensional active learning activities that can be applied in the classroom."*

Activities with Greatest Impact on Teachers' Thinking or Feelings

Content analysis of responses to the question "Which activity or session in the training program had the greatest impact on your thinking or feelings? And why?" revealed several significant patterns, as presented in Table 5.

Table 5. Frequency and percentage of training activities with greatest ımpact on teachers' thinking or feelings

Impactful Activities	Frequency	Percentage
1. Letter Writing to Self Activity (after watching "Gratitude" video)	21	42.00
2. Thinking and Problem-Solving Activities	8	16.00
- Tower of Hanoi Activity (using plastic boxes)	5	10.00
- Card Pyramid Construction Activity	1	2.00
- Critical Thinking Activities (unspecified)	2	4.00
3. Video Clip Viewing Activities	6	12.00
- "Gratitude: What Measures a Person's Value?" Video	5	10.00
- America's Got Talent (AGT) Clip on Critical Thinking	1	2.00
4. Experience/Idea Exchange Activities	4	8.00
5. Project Design/PBL Activities	3	6.00
6. All Activities	3	6.00
7. Others	1	2.00
No Response/No Reason Given	4	8.00

Note: Table shows frequency of activities mentioned by teachers from a total of 50 respondents, calculated as percentage of all teachers mentioning each activity. Some teachers mentioned multiple activities.

The self-reflection letter writing activity, conducted after viewing the "Gratitude" video, had the most significant impact on teachers (42.00%). This activity emphasized deep reflection and connection with personal feelings. Teachers reported that this activity allowed them to "express emotions," "reflect on their lives," and "encourage themselves."

The second most impactful were thinking and problem-solving activities (16.00%), particularly the Tower of Hanoi adaptation (10.00%), which teachers described as "stimulating thinking" and "clearly drawing out thinking abilities." Video viewing activities (12.00%) also significantly affected teachers' thinking and feelings, especially the "Gratitude" video.

Interestingly, the activities that teachers identified as most impactful primarily engaged the emotional dimension, suggesting that the 'ACTIVE' Training Program effectively reached teachers' emotional dimension. This reflects a balance between cognitive and emotional development, aligning with the core principles of the Four-Dimensional Active Learning approach that emphasizes holistic learner development.

Representative quotes included:

> *Regarding the letter writing activity: "The self-love letter activity allowed me to express emotions, thoughts, life goals, and the path I need to follow."*
>
> *Regarding thinking and problem-solving activities: "The Tower of Hanoi activity stimulated thinking, and pairing to exchange teaching experiences with others facilitated knowledge and experience sharing."*
>
> *Regarding video viewing activities: "The video activity showing a teacher taking their mother to school made me think about those watching over my success and gave me strength to continue."*

Changes in Perspectives or Understanding After Training

Content analysis of responses to the question "What did you previously view or understand in one way that changed after participating in this training program?" revealed significant transformations in teachers' perspectives, as presented in Table 6.

Table 6. Frequency and percentage of changes in teachers' perspectives or understanding after training

Changes in Perspectives or Understanding	Frequency	Percentage
1. Understanding of Concepts and Principles	22	44.00
- Four-Dimensional Active Learning	5	10.00
- Project-Based Learning (PBL)	4	8.00
- Key Competency-Based Learning	5	10.00
- Teaching and Learning Overall	8	16.00
2. Teaching Skills and Techniques	11	22.00
- Open-Ended Questioning	2	4.00
- Higher-Order/Diverse Thinking Processes	5	10.00
- Teaching Flexibility	3	6.00
- Other Teaching Techniques	1	2.00
3. Integration and Application	4	8.00
- Integration Across Subject Areas	2	4.00
- Classroom Application	2	4.00
4. Perspectives on Training	1	2.00
5. Emotional and Feeling Aspects	2	4.00
6. No Change/Not Clearly Specified	5	10.00
No Response	5	10.00

Note: Table shows frequency of perspective changes mentioned by teachers from a total of 50 respondents, calculated as percentage of all teachers mentioning each change. Some teachers mentioned multiple changes.

The most significant changes in teachers' perspectives occurred in their understanding of concepts and principles (44.00%), particularly regarding teaching and learning overall (16.00%), four-dimensional active learning (10.00%), and key competency-based learning (10.00%). The second most significant area of change involved teaching skills and techniques (22.00%), especially higher-order/diverse thinking processes (10.00%).

An interesting finding was one teacher's changed perspective on professional development itself, stating: *"I used to think training was boring but not with this training program,"* indicating that the 'ACTIVE' Training Program was engaging and effectively captured teachers' interest. Additionally, some teachers reported changes in emotional states, such as "reduced anxiety," demonstrating that the training affected not only cognitive and skill domains but also emotional well-being.

Representative quotes included:

Regarding concepts and principles: *"After participating in the training, many perspectives changed, especially regarding shifting from content teaching to creating learning experiences."*

Regarding teaching skills: *"Using open-ended questions before teaching to promote higher-order thinking in students."*

Regarding integration and application: *"I learned that PBL teaching can be integrated across multiple subject areas and can be applied in future teaching."*

Intentions to Apply Knowledge from the Training Program

Content analysis of responses to the question "How do you intend to apply what you learned from this training program?" revealed strong motivation for classroom implementation, as presented in Table 7.

Table 7. Frequency and percentage of teachers' ıntentions to apply knowledge from the training program

Intentions to Apply Knowledge	Frequency	Percentage
Application in Teaching and Learning	41	82.00
- Designing and Implementing Active Learning Activities	15	30.00
- Teaching with Four-Dimensional Active Learning	7	14.00
- Teaching Based on Five Key Competencies	5	10.00
- Project-Based Learning (PBL) Implementation	5	10.00
- Application in Specific Subject Contexts	4	8.00
- General Application (unspecified)	5	10.00
Application in Specific Teaching Steps	8	16.00
- Lesson Introduction/Interest Stimulation	4	8.00
- Questioning and Participation Creation	2	4.00
- Games and Movement Activities	2	4.00
Lesson Plan Development	6	12.00
Self-Development	3	6.00
No Response/Not Clearly Specified	2	4.00

Note: Table shows frequency of intended applications mentioned by teachers from a total of 50 respondents, calculated as percentage of all teachers mentioning each intention. Some teachers mentioned multiple intentions.

Most common intention among teachers was application in teaching and learning (82.00%), particularly designing and implementing active learning activities (30.00%), followed by teaching with four-dimensional active learning (14.00%), teaching based on five key competencies (10.00%), and project-based learning implementation (10.00%).

Teachers also intended to apply their knowledge in specific teaching steps (16.00%), especially during lesson introductions and interest stimulation (8.00%), as well as in lesson plan development (12.00%). Some teachers (6.00%) mentioned intentions related to self-development, reflecting the training program's impact on professional growth.

These findings suggest that the 'ACTIVE' Training Program successfully motivated teachers to apply their newly acquired knowledge in authentic contexts, aligning with teacher development goals that aim to create changes at the levels of thinking, understanding, and practice.

Representative quotes included:

> Regarding teaching and learning application: *"I will apply four-dimensional active learning to science teaching, designing learning activities such as the Tower of Hanoi, card pyramid construction, and brain gym for students to solve problems and think together."*
>
> Regarding specific teaching steps: *"I will stimulate questions to increase student participation."*
>
> Regarding lesson plan development: *"I will improve teaching plan writing to cover all four dimensions of active learning and the five competencies."*

Suggestions for Training Program Improvement

Content analysis of responses to the question "Do you have any suggestions for improving or developing this type of training program in the future?" revealed several key themes, as presented in Table 8.

Table 8: Frequency and percentage of suggestions for training program ımprovement

Suggestions for Program Improvement	Frequency	Percentage
1. Time Management Improvements	14	28.00
- Increasing activity time	10	20.00
- Increasing training frequency	2	4.00
- Time-related comments (unspecified)	2	4.00
2. Venue and Facilities Improvements	5	10.00
3. Activity Implementation Improvements	3	6.00
4. No Suggestions/Satisfaction with Training	19	38.00
5. No Response	7	14.00
6. Unclear Suggestions	2	4.00
Total	50	100.00

Note: *Table shows frequency of suggestions mentioned by teachers from a total of 50 respondents, calculated as percentage of all teachers mentioning each suggestion.*

A significant proportion of teachers (38.00%) had no suggestions or expressed satisfaction with the training program, suggesting that it met their needs to a considerable extent. The principal suggestion for future training development was "Time Management Improvements" (28.00%), particularly "Increasing activity time" (20.00%), reflecting that the training activities were perceived as valuable but time might have been insufficient for optimal learning.

The second most common suggestion concerned "Venue and Facilities Improvements" (10.00%), followed by "Activity Implementation Improvements" (6.00%). These suggestions provide valuable input for future development of similar training programs.

Representative quotes included:

Regarding time management: *"Extend the time for each activity to make each activity more effective."*

Regarding venue improvements: *"I would like the table arrangement to be modified, as the current setup affects participants sitting at the back who cannot hear the trainer clearly."*

Regarding satisfaction: *"None. It was a very perfect training program."*

Additional Suggestions

Content analysis of responses to the open-ended question "Additional suggestions (if any)" revealed several themes, as presented in Table 9.

Table 9. *Frequency and Percentage of Additional Suggestions*

Additional Suggestions	Frequency	Percentage
1. Activity and Content Suggestions	3	6.00
2. Organizational Suggestions	11	22.00
- Increase duration	4	8.00
- Request for similar training programs in the future	2	4.00
- Teachers wanting to extend learning to develop more diverse teaching activities	2	4.00
- Venue for activities	2	4.00
- Organize more teacher development training like this	1	2.00
3. General Satisfaction	3	6.00
4. No Additional Suggestions	19	38.00
5. No Response	14	28.00
Total	50	100.00

Note: Table shows frequency of additional suggestions mentioned by teachers from a total of 50 respondents, calculated as percentage of all teachers mentioning each suggestion.

The majority of teachers either had no additional suggestions (38.00%) or did not respond to this question (28.00%), which may indicate that teachers had already provided their feedback in previous questions. Some teachers offered

additional suggestions, particularly regarding organizational aspects (22.00%), primarily related to increasing the duration (8.00%) and requests for similar training programs in the future (6.00% combined). Suggestions related to activities and content (6.00%) focused on increasing practical learning based on current situations and requests for training on other topics. Additionally, some teachers expressed general satisfaction with the training program (6.00%).

These additional suggestions reflect teachers' desire for continuous professional development and their satisfaction with the ACTIVE Training Program, which can inform future training program planning to more effectively respond to teachers' needs.

Teachers' Satisfaction with the Training Program

Satisfaction with the Training Program

Analysis of satisfaction data from 50 participating teachers across all evaluation categories revealed consistently high satisfaction levels as presented in Table 10.

Table 10. Mean, standard deviation, and satisfaction levels with the training program

Satisfaction Items	Mean	SD	Level
Category 1: Content Satisfaction	4.79	0.45	Highest
Category 2: Training Process Satisfaction	4.90	0.33	Highest
Category 3: Trainer and Atmosphere Satisfaction	4.95	0.22	Highest
Overall Mean	4.88	0.33	Highest

Note: Interpretation criteria for mean scores: 1.00-1.80 = lowest, 1.81-2.60 = low, 2.61-3.40 = moderate, 3.41-4.20 = high, 4.21-5.00 = highest

Participating teachers reported the highest level of satisfaction with the overall training program (Mean = 4.88, SD= 0.33). Category 3: Trainer and Atmosphere Satisfaction received the highest satisfaction rating (Mean = 4.95, SD = 0.22), with "Overall satisfaction with this training program" scoring highest (Mean = 4.96, SD = 0.20). Category 2: Training Process Satisfaction followed (Mean = 4.90, SD = 0.33), with highest ratings for "Training activities were diverse and inspiring" and "Process fostered participation through diverse activities" (both Mean = 4.92, SD = 0.27).

The highest-rated individual aspects were: overall satisfaction (4.96), trainer's clarity and friendly atmosphere (4.94), and diverse and inspiring activities (4.92). These findings indicate that the 'ACTIVE' Training Program was highly successful across all dimensions, particularly regarding the trainer, atmosphere, and the process that emphasized diverse activities, participation, and hands-on practice. This aligns with effective teacher development principles that emphasize creating learning experiences that lead to actual changes in classroom practice.

Analysis of What Training Participants Found Most Impressive

From detailed examination of responses from all 50 training participants regarding what they found most impressive about the training, the following patterns emerged:

Table 11. Categories of ımpressive aspects in training

Category of Impressive Aspects	**Frequency**	**Percentage**
- Trainer (friendliness, engaging teaching, clear explanations)	16	32.00
- Diverse and interesting activities	10	20.00
- All activities in the training	7	14.00
- Training atmosphere (fun, relaxed, engaging)	6	12.00
- Specific activities (Tower of Hanoi, blindfolded walking, video clips)	5	10.00
- 4-Dimensional Active Learning activities	3	6.00
- Participant engagement	2	4.00
- Practical application of knowledge	1	2.00

Approximately one-third of participants (32.00%) identified the trainer as the most impressive aspect, noting qualities such as friendliness, clear explanations, and engaging teaching style. One-fifth of participants (20.00%) appreciated the

diversity of activities, which they found intellectually challenging while maintaining interest. The training atmosphere (12.00%) was also highlighted for being relaxed yet productive.

Representative quotes included: *"Impressed by the trainer, with engaging teaching that wasn't boring and delivered substantial content"* and *"Activities that grabbed attention because they were exciting and stimulated thinking and challenge."*

The key factors contributing to the success of the 'ACTIVE' Training Program were: quality trainers (32.00%), diverse and engaging activities (20.00%), positive learning environment (12.00%), emotional engagement through activities like the mother video (10.00%), and strong theory-practice connections (8.00% combined from 4-Dimensional Active Learning activities and practical application).

These findings suggest that effective teacher training programs should prioritize trainer quality, maintain diverse activities, foster positive atmospheres, include emotionally engaging elements, and strengthen connections between theory and classroom practice.

Analysis of Activities with Greatest Impact on Participants' Learning

After detailed re-examination of responses from all 50 participants regarding which activities had the greatest impact on their learning, the following patterns emerged:

Table 12. Activities with greatest ımpact on participants' learning

Activities with Greatest Learning Impact	Frequency	Percentage
- Project-Based Learning (PBL)	11	22.00
- All training activities	7	14.00
- Tower of Hanoi activity	6	12.00
- Letter writing to self activity	4	8.00
- 4-Dimensional Active Learning concept	4	8.00
- Other specified activities	9	18.00
- Unclear responses/off-topic answers	9	18.00

Project-Based Learning (PBL) had the greatest impact on participants' learning (22.00%), with teachers noting that *"PBL activities can be adapted to enhance science projects, making them more interesting and creative."* The second most impactful was the collective experience of all training activities (14.00%), with participants stating these *"increased experience and knowledge for future use with students."* The Tower of Hanoi activity ranked third (12.00%), described as *"both fun and thought-provoking"* and *"requiring planning"* skills.

Other significant activities included the letter writing to self activity (8.00%), which *"allowed us to know ourselves and what we're currently thinking,"* and the 4-Dimensional Active Learning concept (8.00%), which provided a comprehensive framework for instruction.

These findings suggest that effective teacher training programs should:

- Emphasize Project-Based Learning with increased practice time
- Maintain diverse activities that can be directly applied in teaching
- Include cognitive challenges like the Tower of Hanoi that model thinking skills
- Balance academic content with reflective activities for holistic professional development
- Connect theoretical concepts with classroom applications

The 'ACTIVE' Training Program successfully incorporated a variety of activities that impacted learning in different ways, with PBL having the greatest impact, aligning with the research objective of developing teachers' competency-based active learning and project-based learning management skills.

Analysis of Concepts and Methods Participants Intend to Apply in Learning Management

After examining responses from all 50 participants regarding concepts or methods they intend to apply in their learning management, the following patterns emerged:

Table 13. Concepts and methods participants ıntend to apply in learning management

Concepts/Methods to Apply	Frequency	Percentage
Attention activities/Brain Gym	6	12.00
Games and interest-stimulating activities	6	12.00
Integrated teaching	5	10.00
4-Dimensional Active Learning activities	5	10.00
Project-Based Learning (PBL)	4	8.00
Activities promoting student thinking and expression	4	8.00
Other specified approaches	8	16.00
Unclear responses/No answer	12	24.00

The most frequently mentioned concepts were attention activities/Brain Gym and games/interest-stimulating activities (12.00% each), with teachers noting these would *"stimulate greater interest in learning"* and *"help with the lesson introduction process."* Integrated teaching and 4-Dimensional Active Learning activities (10.00% each) followed closely, with participants intending to *"organize teaching to cover all 4 dimensions"* and *"integrate all activities to best suit students."*

Project-Based Learning (PBL) and activities promoting student thinking (8.00% each) were also prioritized, aligning with core training objectives. However, a significant proportion of participants (24.00%) provided unclear responses or no answer, suggesting a need for more concrete application planning.

Based on these findings, recommendations for promoting knowledge application include:

- Organize practical application workshops with concrete planning activities
- Develop subject-specific application guides and sample lesson plan
- Establish post-training support systems and teacher learning networks
- Enhance reflective processes and implementation planning during training
- Create follow-up mechanisms to support actual classroom implementation

Most participants intended to apply concepts from the 'ACTIVE' Training Program in their teaching practice, particularly focusing on student engagement techniques, integrated teaching approaches, and activity-based learning. However, the high percentage of unclear responses indicates a need for more structured application planning to ensure training leads to genuine changes in classroom practice.

Analysis of Concepts and Methods Participants Plan to Apply in Future Teaching

Examination of responses from all 50 participants regarding concepts or methods they plan to apply in future teaching revealed the following patterns:

Table 14. Concepts and methods participants plan to apply in future teaching

Concepts/Methods to Apply	Frequency	Percentage
Improving teaching processes	6	12.00
Attention activities/Brain Gym	5	10.00
Project-Based Learning (PBL)	3	6.00
Integrated teaching	3	6.00
Games and interest-stimulating activities	3	6.00
Other specified approaches	6	12.00
Unclear responses/No answer/None	24	48.00

The most concerning finding was that nearly half of participants (48.00%) provided unclear responses, no answer, or indicated "None," suggesting potential challenges in knowledge transfer. Among those who provided clear responses,

improving teaching processes (12.00%) was most frequently mentioned, though often without specific methods: "New and diverse teaching approaches" and "Teaching that reaches children more effectively."

Attention activities/Brain Gym (10.00%) was the second most mentioned approach, with participants noting these would "stimulate greater interest in learning." Project-Based Learning, integrated teaching, and games/interest-stimulating activities (each 6.00%) were also identified as approaches participants planned to implement.

Based on these findings, recommendations for promoting knowledge application include:

- Improve assessment and data collection methods to better capture application intentions
- Incorporate concrete planning activities at the end of training sessions
- Develop subject-specific case studies and sample lesson plans
- Establish post-training support systems and professional learning communities
- Create incentive systems to recognize effective knowledge application
- Provide follow-up training on high-interest topics

This analysis indicates that while some participants from the 'ACTIVE' Training Program had clear intentions for application, there is a significant need to strengthen the connection between training and implementation, particularly through structured application planning and ongoing support systems.

Analysis of General Suggestions for Training Improvement

Analysis of responses from all 50 participants regarding general suggestions for training improvement revealed the following patterns:

Table 15. General suggestions for training ımprovement

Type of Suggestion	Frequency	Percentage
Increase training duration	9	18.00
Venue arrangement	5	10.00
Training frequency	3	6.00
Training timing	1	2.00
Satisfaction/compliments	3	6.00
No suggestions	12	24.00
No response	17	34.00

Increased training duration was the most frequent suggestion (18.00%), with participants noting that *"activities were fun and provided much knowledge, but time was limited."* Venue arrangement followed (10.00%), with specific concerns about table setup affecting learning efficiency. Some participants (6.00%) requested continuous training sessions, suggesting *"hold training once per semester"* to sustain professional development.

Notably, a majority of participants (58.00%) either indicated "no suggestions" (24.00%) or provided no response (34.00%), which may reflect general satisfaction with the training or insufficient appreciation for the importance of feedback.

Based on these findings, recommendations for improving future training include:

- Extend training duration, especially for activities requiring deeper thought and practice
- Improve venue arrangements to enhance participation and learning efficiency
- Plan continuous training sessions on a regular schedule (e.g., once per semester)
- Consider scheduling training before semester begins when teachers have fewer responsibilities
- Enhance evaluation methods to increase response rates and quality of feedback
- Develop a continuous improvement plan based on participant suggestions

These recommendations could help the 'ACTIVE' Training Program better meet participants' needs and enhance its effectiveness in developing teachers' competency-based active learning and project-based learning skills.

Discussion

This study examined the ACTIVE Training Program's impact on teachers' competency-based and active learning design capabilities. Results show significant improvements, with a normalized gain index of 0.77, demonstrating the program's effectiveness. The discussion addresses six key areas: teachers as learning designers, practice-based professional development, emotional engagement, implementation readiness and barriers, teacher agency, and methodological considerations. These findings align with national and international educational reforms, particularly Thailand's shift toward competency-based learning frameworks.

Teachers as Learning Designers in a Competency-Based Framework

The significant increase in teachers' knowledge—from 9.68 to 17.58 points—reflects their enhanced understanding of competency-based education (CBE) and their evolving role as learning designers. This shift aligns with OECD's (2019, 2021) vision of teachers as co-creators of learning experiences that integrate knowledge, skills, attitudes, and values (Paniagua & Istance, 2018). In the Thai context, Sangwanglao (2024) emphasized that implementing CBE effectively requires equipping teachers with design capacity and curriculum adaptability. The World Economic Forum (2024) also advocates personalized, purpose-driven education, where teachers are empowered to shape learning paths. High-quality professional development supports this transformation by connecting theory to practice (Darling-Hammond et al., 2017; OECD/UNESCO, 2016).

Impact of Structured, Practice-Based Professional Development

The high performance in learning design (82.87%) underscores the effectiveness of structured, experiential professional development (PD). Kolb's (1984) experiential learning cycle and Schön's (1983) reflective practitioner framework provide a theoretical foundation for the ACTIVE training program. These principles are echoed in recent studies emphasizing the role of active engagement, experimentation, and contextual reflection in sustainable PD (Ajani, 2023; OECD, 2018). Effective PD fosters deep understanding and practice transfer, especially when grounded in relevant, classroom-based tasks (Darling-Hammond et al., 2017).

Emotional Engagement and Reflective Transformation

The "letter to self" activity—identified as the most impactful by 42% of participants—demonstrated the role of emotional connection in transformative learning. Mezirow (1991) asserts that perspective shifts often begin with emotionally disorienting experiences, which trigger critical reflection. Knowles (1984) supports this through adult learning theory, in which autonomy and personal relevance drive intrinsic motivation. Recent perspectives reaffirm that emotional engagement enhances learning depth and retention in teacher development (Ajani, 2023; Fleming, 2018; Schön, 1983).

Readiness and Barriers to Implementation

While 82% of participants expressed intent to apply new knowledge—particularly through PBL and attention-stimulating activities—variation in response depth suggests differing levels of readiness. The Concerns-Based Adoption Model (CBAM) explains that teachers must progress through affective and behavioral stages to achieve successful implementation (Hall & Hord, 2015; SEDL, 2010). Similarly, the SAMR model helps analyze how innovations are adopted and transformed in practice (Hamilton et al., 2016). In Thailand, Sethakul and Utakrit (2019) identified systemic barriers such as rigid curricula and limited institutional support as key obstacles. Therefore, post-training support mechanisms like coaching, PLCs, and responsive leadership are crucial to sustaining change (LPI, 2017; WEF, 2023).

Satisfaction and Emergent Teacher Agency

The high overall satisfaction rating (M = 4.88) reflects more than positive sentiment—it signals a growing sense of teacher agency. Agency, as defined by Priestley et al. (2015), is an ecological construct shaped by capacity, context, and culture. Teachers' reflections indicated ownership of learning and intention to lead change—aligning with Biesta et al. (2015), who argue that agency involves purposeful, professional action. PD that supports autonomy, dialogue, and emotional engagement fosters this development (OECD, 2021; Sethakul & Utakrit, 2019).

Methodological Limitations and Future Research Directions

This study employed a pre-experimental design without a comparison group, which limits causal inference. Creswell and Guetterman (2019) recommend quasi-experimental and longitudinal designs for more robust evaluation. Caruana et al. (2015) and Desimone et al. (2002) emphasize that teacher learning outcomes should be tracked over time to understand sustainability. Antoniou and Kyriakides (2013) propose dynamic PD models that include embedded evaluation cycles. In the Thai context, Sangwanglao (2024) calls for longitudinal research to examine the alignment between policy expectations and classroom realities—reinforcing the importance of evidence-informed reform strategies.

Conclusion

The ACTIVE Training Program significantly enhanced teachers' competencies in implementing active learning and project-based learning approaches, as evidenced by the high normalized gain index and strong learning activity design capabilities. Key success factors included emotionally engaging activities, particularly the letter writing activity and project-based learning experiences, collaborative practices, and structured design tasks. The high satisfaction ratings confirm the program's effectiveness. This study highlights the importance of positioning teachers as learning designers, balancing theory with practice, incorporating emotional engagement in professional development, and providing systematic post-training support. Despite methodological limitations, the findings offer valuable insights for teacher development in Thailand's educational reform context. Future research should examine implementation sustainability through longitudinal and comparative studies.

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